DUAL 4-PORT AND DUAL 8-PORT LVDS REPEATERS

FEATURES

- **Two Line Receivers and Eight ('109) or Sixteen ('117) Line Drivers Meet or Exceed the Requirements of ANSI EIA/TIA-644 Standard**
- **Typical Data Signaling Rates to 400 Mbps or Clock Frequencies to 400 MHz**
- **Outputs Arranged in Pairs From Each Bank**
- **Enabling Logic Allows Individual Control of Each Driver Output Pair, Plus All Outputs**
- **Low-Voltage Differential Signaling With Typical Output Voltage of 350 mV and a 100-Ω Load**
- **Electrically Compatible With LVDS, PECL, LVPECL, LVTTL, LVCMOS, GTL, BTL, CTT, SSTL, or HSTL Outputs With External Termination Networks**
- **Propagation Delay Times < 4.5 ns**
- **Output Skew Less Than 550 ps Bank Skew Less Than150 ps Part-to-Part Skew Less Than 1.5 ns**
- **Total Power Dissipation Typically <500 mW With All Ports Enabled and at 200 MHz**
- **Driver Outputs or Receiver Input Equals High Impedance When Disabled or With V_{CC} < 1.5 V**
- **Bus-Pin ESD Protection Exceeds 12 kV**
- **Packaged in Thin Shrink Small-Outline Package With 20-Mil Terminal Pitch**

DESCRIPTION

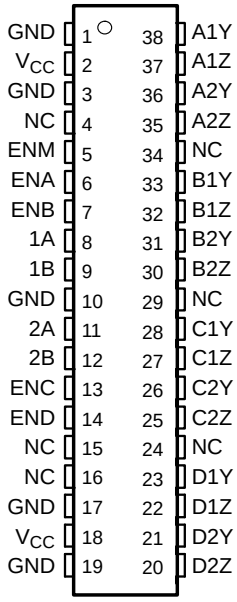
The SN65LVDS109 and SN65LVDS117 are configured as two identical banks, each bank having one differential line receiver connected to either four ('109) or eight ('117) differential line drivers. The outputs are arranged in pairs having one output from each of the two banks. Individual output enables are provided for each pair of outputs and an additional enable is provided for all outputs.

The line receivers and line drivers implement the electrical characteristics of low-voltage differential signaling (LVDS). LVDS, as specified in EIA/TIA-644, is a data signaling technique that offers low power, low noise emission, high noise immunity, and high switching speeds. (Note: The ultimate rate and distance of data transfer is dependent upon the attenuation characteristics of the media, the noise coupling to the environment, and other system characteristics.)

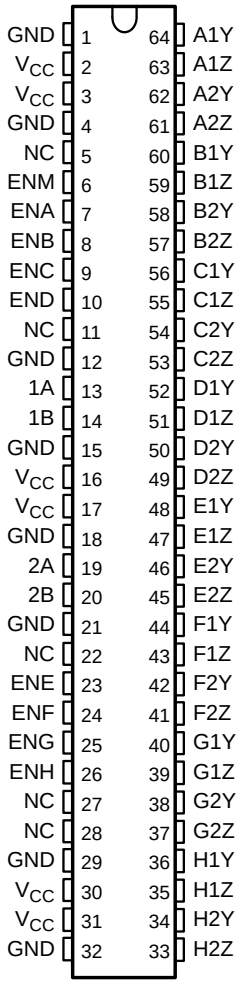
The intended application of these devices, and the LVDS signaling technique, is for point-to-point or point-to-multipoint (distributed simplex) baseband data transmission on controlled impedance media of approximately 100 Ω. The transmission media may be printed-circuit board traces, backplanes, or cables. The large number of drivers integrated into the same silicon substrate, along with the low pulse skew of balanced signaling, provides extremely precise timing alignment of the signals being repeated from the inputs. This is particularly advantageous for implementing system clock and data distribution trees.

The SN65LVDS109 and SN65LVDS117 are characterized for operation from –40°C to 85°C.

SN65LVDS109
DBT PACKAGE
(TOP VIEW)



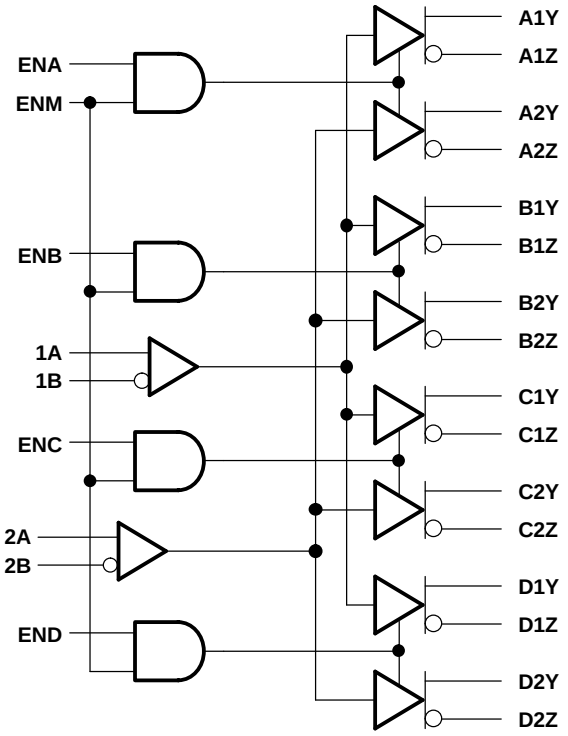
SN65LVDS117
DGG PACKAGE
(TOP VIEW)



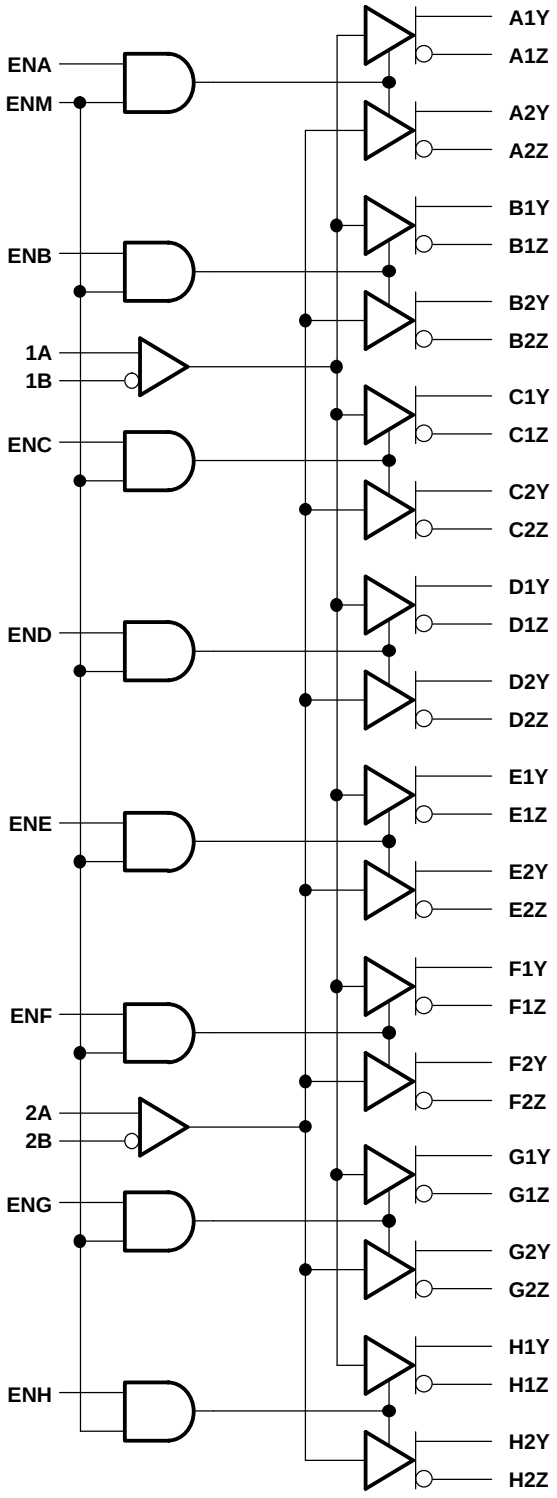
These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

LOGIC DIAGRAM (POSITIVE LOGIC)

SN65LVDS109



SN65LVDS117



SELECTION GUIDE TO LVDS SPLITTERS

The SN65LVDS109 and SN75LVDS117 are both members of a family of LVDS splitters and repeaters. A brief overview of the family is provided by Table 1.

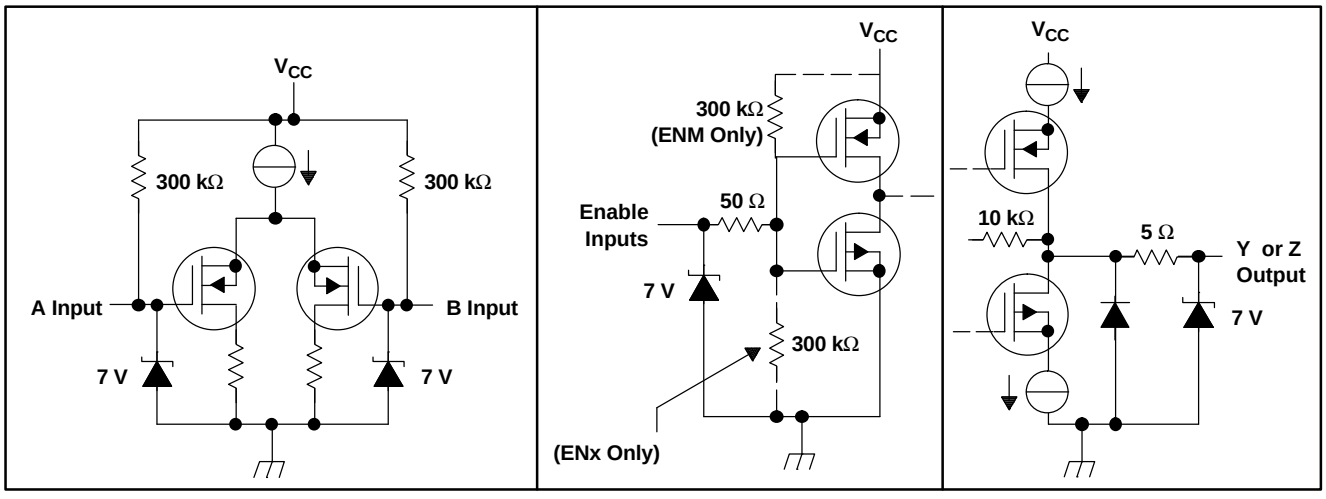
Table 1. LVDS SPLITTER AND REPEATER FAMILY

DEVICE	NUMBER OF INPUTS	NUMBER OF OUTPUTS	PACKAGE	COMMENTS
SN65LVDS104	1 LVDS	4 LVDS	16-pin D	4-Port LVDS repeater
SN65LVDS105	1 LVTTL	4 LVDS	16-pin D	4-Port TTL-to-LVDS repeater
SN65LVDS108	1 LVDS	8 LVDS	38-pin DBT	8-Port LVDS repeater
SN65LVDS109	2 LVDS	8 LVDS	38-pin DBT	Dual 4-port LVDS repeater
SN65LVDS116	1 LVDS	16 LVDS	64-pin DGG	16-Port LVDS repeater
SN65LVDS117	2 LVDS	16 LVDS	64-pin DGG	Dual 8-Port LVDS repeater

FUNCTION TABLE

INPUTS			OUTPUTS	
$V_{ID} = V_A - V_B$	ENM	ENx	$\overline{xY}$	$\overline{xZ}$
X	L	X	Z	Z
X	X	L	Z	Z
$V_{ID} \geq 100$ mV	H	H	H	L
-100 mV $< V_{ID} < 100$ mV	H	H	?	?
$V_{ID} \leq -100$ mV	H	H	L	H

EQUIVALENT INPUT AND OUTPUT SCHEMATIC DIAGRAMS



ABSOLUTE MAXIMUM RATINGS

over operating free-air temperature range (unless otherwise noted)(1)

		UNIT
Supply voltage range, V_{CC}(2)		–0.5 V to 4 V
Input voltage range	Enable inputs	–0.5 V to 6 V
	A, B, Y or Z	–0.5 V to 4 V
Electrostatic discharge	A, B, Y, Z, and GND(3)	Class 3, A:12 kV, B: 500 V
Continuous power dissipation		See Dissipation Rating Table
Storage temperature range		–65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds		260°C

(1) Stresses beyond those listed under *absolute maximum ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *recommended operating conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) All voltage values, except differential I/O bus voltages, are with respect to network ground terminal.
(3) Tested in accordance with MIL-STD-883C Method 3015.7.

DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25°C$ POWER RATING	DERATING FACTOR(1) ABOVE $T_A = 25°C$	$T_A = 85°C$ POWER RATING
DBT	1277 mW	10.2 mW/°C	644 mW
DGG	2094 mW	16.7 mW/°C	1089 mW

(1) This is the inverse of the junction-to-ambient thermal resistance when board-mounted (low-k) with no air flow.

RECOMMENDED OPERATING CONDITIONS

		MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage	3	3.3	3.6	V
V_{IH}	High-level input voltage	2			V
V_{IL}	Low-level input voltage			0.8	V
V_I or V_{IC}	Voltage at any bus terminal (separately or common-mode)	0		V_{CC}– 0.8	V
T_A	Operating free-air temperature	–40		85	°C

ELECTRICAL CHARACTERISTICS

over recommended operating conditions (unless otherwise noted)

PARAMETER			TEST CONDITIONS	MIN	TYP(1)	MAX	UNIT
V_{ITH+}	Positive-going differential input voltage threshold		See Figure 1 and Table 2			100	mV
V_{ITH-}	Negative-going differential input voltage threshold			–100			
$\|V_{OD}\|$	Differential output voltage magnitude		R_L = 100 Ω, V_{ID} = ±100 mV, See Figure 1 and Figure 2	247	340	454	mV
$\Delta\|V_{OD}\|$	Change in differential output voltage magnitude between logic states			–50		50	
$V_{OC(SS)}$	Steady-state common-mode output voltage		See Figure 3	1.125		1.375	V
$\Delta V_{OC(SS)}$	Change in steady-state common-mode output voltage between logic states			–50		50	mV
$V_{OC(PP)}$	Peak-to-peak common-mode output voltage				50	150	
I_{CC}	Supply current	SN65LVDS109	Enabled, R_L = 100 Ω		46	64	mA
			Disabled		6	8	
		SN65LVDS117	Enabled, R_L = 100 Ω		85	122	
			Disabled		6	8	
I_I	Input current (A or B inputs)		V_I = 0 V	–2		–20	µA
			V_I = 2.4 V	–1.2			
$I_{I(OFF)}$	Power-off input current (A or B inputs)		V_{CC} = 1.5 V, V_I = 2.4 V			20	µA
I_{IH}	High-level input current (enables)		V_{IH} = 2 V			20	µA
I_{IL}	Low-level input current (enables)		V_{IL} = 0.8 V			10	µA
I_{OS}	Short-circuit output current		V_{OY} or V_{OZ} = 0 V			±24	mA
			V_{OD} = 0 V			±12	
I_{OZ}	High-impedance output current		V_O = 0 V or V_{CC}			±1	µA
$I_{O(OFF)}$	Power-off output current		V_{CC} = 1.5 V, V_O = 3.6 V			±1	µA
C_{IN}	Input capacitance (A or B inputs)		V_I = 0.4 sin (4E6πt) + 0.5 V		5		pF
C_O	Output capacitance (Y or Z outputs)		V_I = 0.4 sin (4E6πt) + 0.5 V, Disabled		9.4		

(1) All typical values are at 25°C and with a 3.3-V supply.

SWITCHING CHARACTERISTICS

over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP(1)	MAX	UNIT
t_{PLH}	Propagation delay time, low-to-high-level output	R_L = 100 Ω, C_L = 10 pF, See Figure 4	1.6	2.8	4.5	ns
t_{PHL}	Propagation delay time, high-to-low-level output		1.6	2.8	4.5	
t_r	Differential output signal rise time		0.3	0.8	1.2	ns
t_f	Differential output signal fall time		0.3	0.8	1.2	
$t_{sk(p)}$	Pulse skew ($\|t_{PHL} - t_{PLH}\|$)(2)			140	500	ps
$t_{sk(o)}$	Output skew(3)			100	550	
$t_{sk(b)}$	Bank skew(4)			40	150	ps
$t_{sk(pp)}$	Part-to-part skew(5)				1.5	ns
t_{PZH}	Propagation delay time, high-impedance-to-high-level output	See Figure 5		5.7	15	ns
t_{PZL}	Propagation delay time, high-impedance-to-low-level output			7.7	15	
t_{PHZ}	Propagation delay time, high-level-to-high-impedance output			3.2	15	
t_{PLZ}	Propagation delay time, low-level-to-high-impedance output			3.2	15	

(1) All typical values are at 25°C and with a 3.3-V supply.
(2) $t_{sk(p)}$ is the magnitude of the time difference between the t_{PLH} and t_{PHL} of any output of a single device.
(3) $t_{sk(o)}$ is the magnitude of the time difference between the t_{PLH} or t_{PHL} of any outputs with both inputs tied together.
(4) $t_{sk(b)}$ is the magnitude of the time difference between the t_{PLH} and t_{PHL} of the two outputs of any bank of a single device.
(5) $t_{sk(pp)}$ is the magnitude of the time difference in propagation delay times between any specified terminals of two devices when both devices operate with the same supply voltages, at the same temperature, and have identical packages and test circuits.

PARAMETER MEASUREMENT INFORMATION

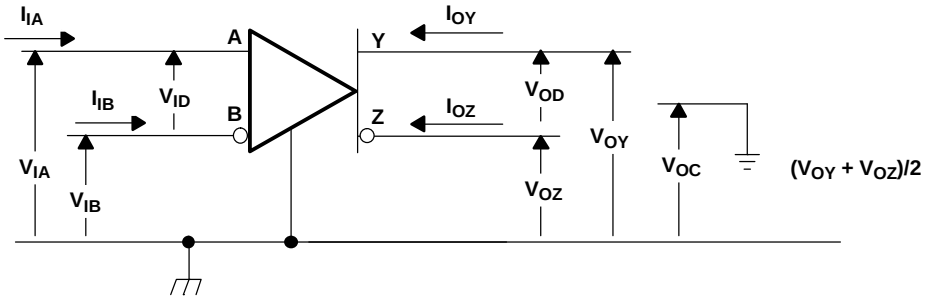


Figure 1. Voltage and Current Definitions

Table 2. Receiver Minimum and Maximum Input Threshold Test Voltages

APPLIED VOLTAGES		RESULTING DIFFERENTIAL INPUT VOLTAGE	RESULTING COMMON-MODE INPUT VOLTAGE
V_{IA}	V_{IB}	V_{ID}	V_{IC}
1.25 V	1.15 V	100 mV	1.2 V
1.15 V	1.25 V	–100 mV	1.2 V
2.4 V	2.3 V	100 mV	2.35 V
2.3 V	2.4 V	–100 mV	2.35 V
0.1 V	0 V	100 mV	0.05 V
0 V	0.1 V	–100 mV	0.05 V
1.5 V	0.9 V	600 mV	1.2 V
0.9 V	1.5 V	–600 mV	1.2 V
2.4 V	1.8 V	600 mV	2.1 V
1.8 V	2.4 V	–600 mV	2.1 V
0.6 V	0 V	600 mV	0.3 V
0 V	0.6 V	–600 mV	0.3 V

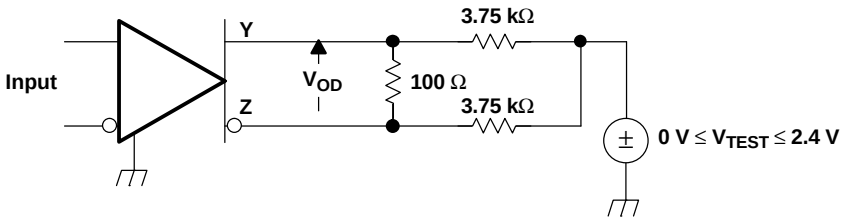
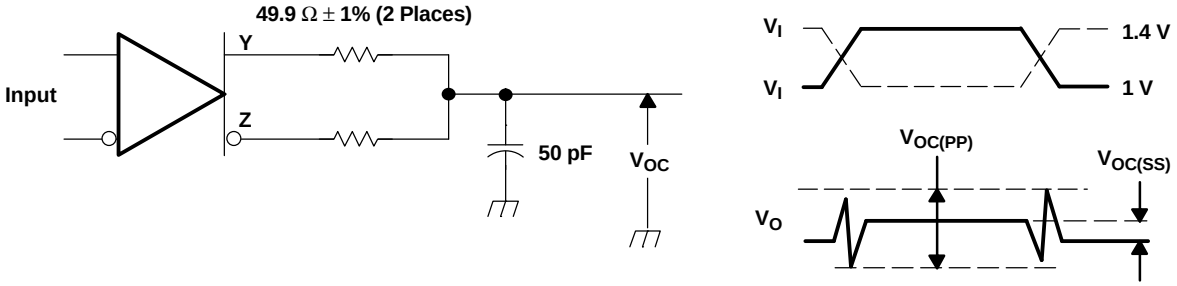
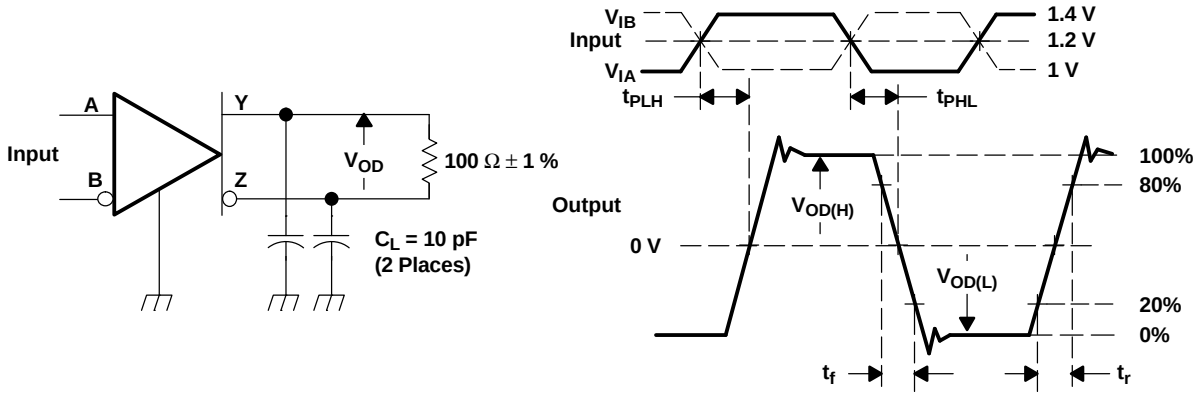


Figure 2. V_{OD} Test Circuit



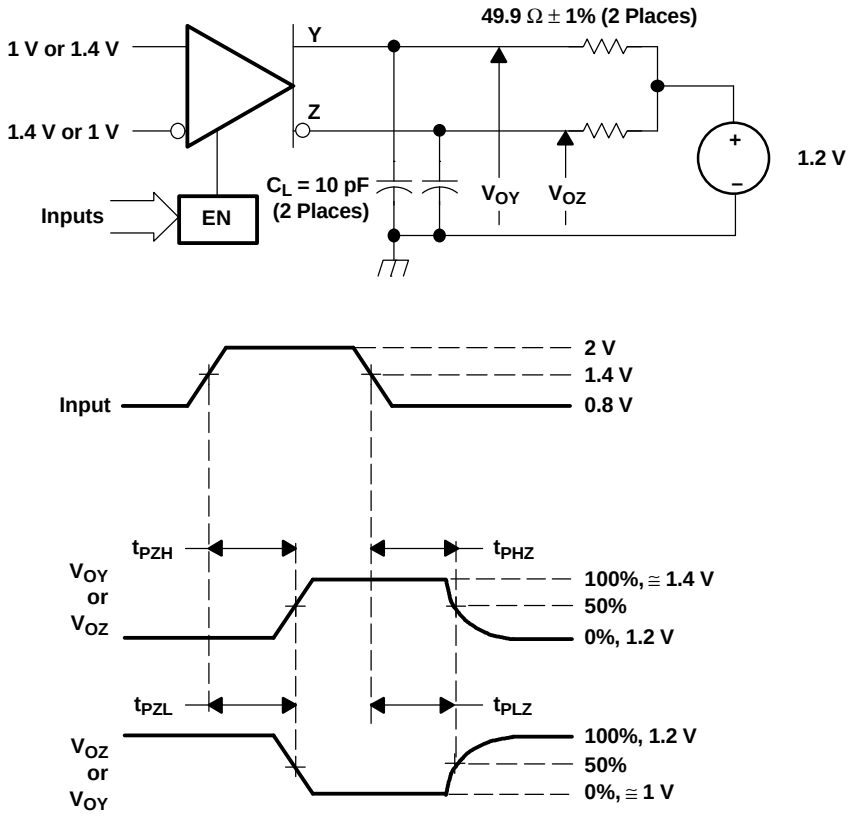
A. All input pulses are supplied by a generator having the following characteristics: t_r or $t_f \le 1$ ns, pulse repetition rate (PRR) = 0.5 Mpps, pulsewidth = 500 ±10 ns. C_L includes instrumentation and fixture capacitance within 0,06 mm of the D.U.T. The measurement of $V_{OC(PP)}$ is made on test equipment with a –3 dB bandwidth of at least 300 MHz.

Figure 3. Test Circuit and Definitions for the Driver Common-Mode Output Voltage



A. All input pulses are supplied by a generator having the following characteristics: t_r or $t_f \le 1$ ns, pulse repetition rate (PRR) = 50 Mpps, pulsewidth = 10 ±0.2 ns . C_L includes instrumentation and fixture capacitance within 0,06 mm of the D.U.T.

Figure 4. Test Circuit, Timing, and Voltage Definitions for the Differential Output Signal



A. All input pulses are supplied by a generator having the following characteristics: t_r or $t_f \leq 1$ ns, pulse repetition rate (PRR) = 0.5 Mpps, pulsewidth = 500 ±10 ns . C_L includes instrumentation and fixture capacitance within 0,06 mm of the D.U.T.

Figure 5. Enable and Disable Time Circuit and Definitions

TYPICAL CHARACTERISTICS

SN65LVDS109
SUPPLY CURRENT
vs
SWITCHING FREQUENCY

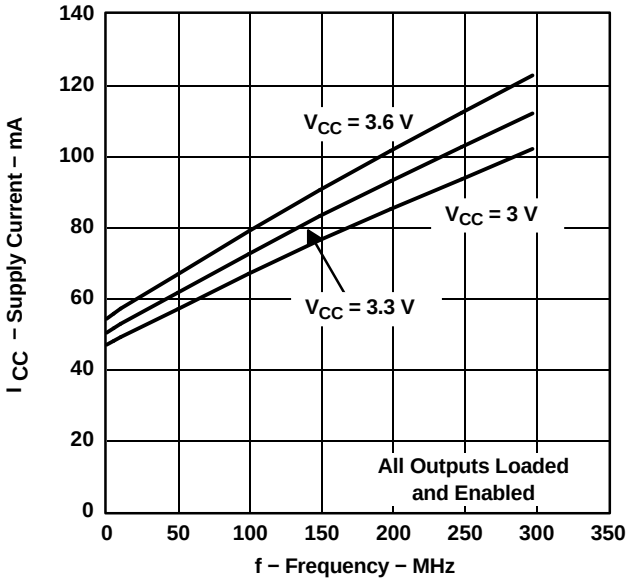


Figure 6.

SN65LVDS117
SUPPLY CURRENT
vs
SWITCHING FREQUENCY

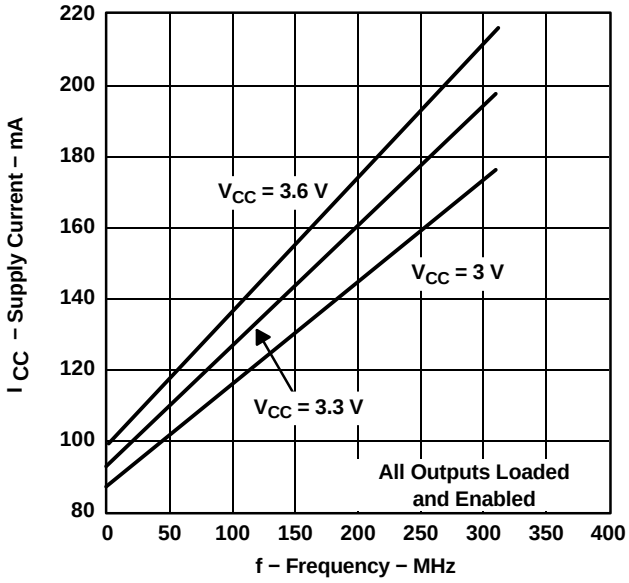


Figure 7.

LOW-TO-HIGH PROPAGATION DELAY TIME
vs
FREE-AIR TEMPERATURE

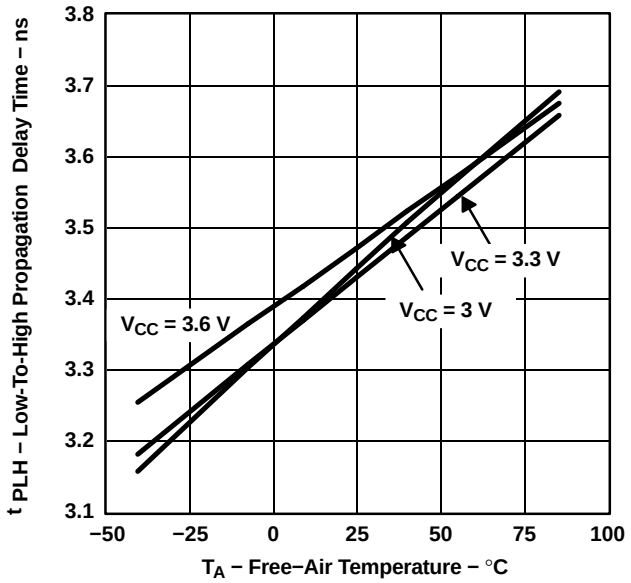


Figure 8.

HIGH-TO-LOW PROPAGATION DELAY TIME
vs
FREE-AIR TEMPERATURE

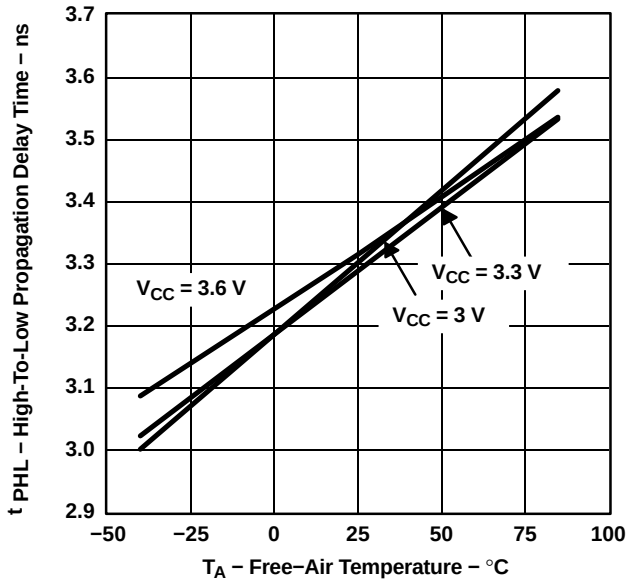
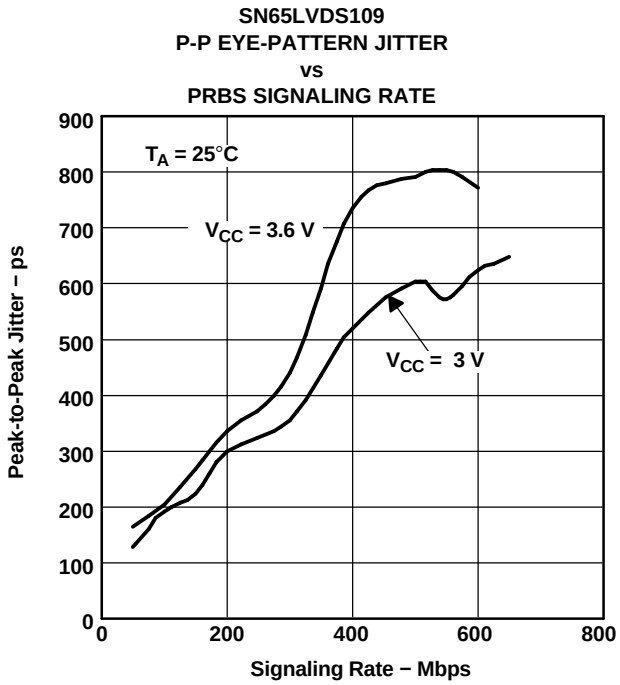


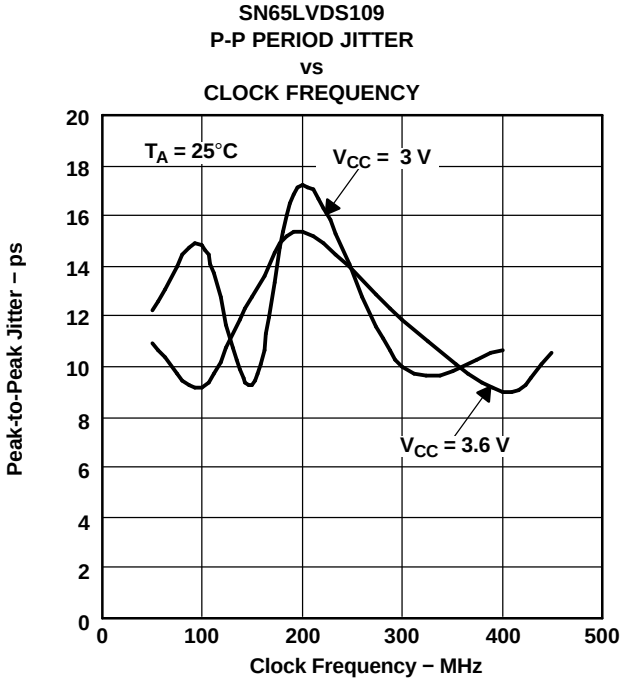
Figure 9.

TYPICAL CHARACTERISTICS (continued)



NOTES: Input: 2^{15} PRBS with peak-to-peak jitter < 100 ps at 100 Mbps, all outputs enabled and loaded with differential 100-Ω loads, worst-case output, supply decoupled with 0.1-µF and 0.001-µF ceramic 0603-style capacitors placed 1 cm from the device.

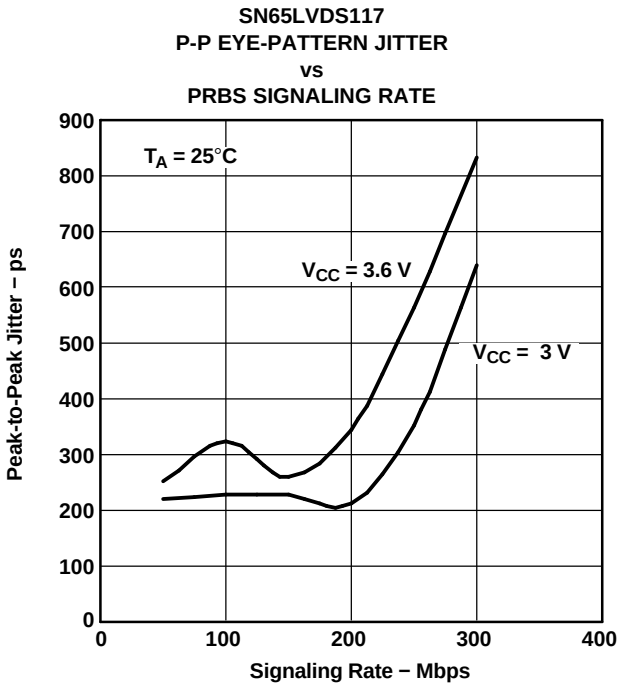
Figure 10.



NOTES: Input: 50% duty cycle square wave with jitter period < 10 ps at 100 MHz, all outputs enabled and loaded with differential 100-Ω loads, worst-case output, supply decoupled with 0.1-µF and 0.001-µF ceramic 0603-style capacitors 1 cm from the device.

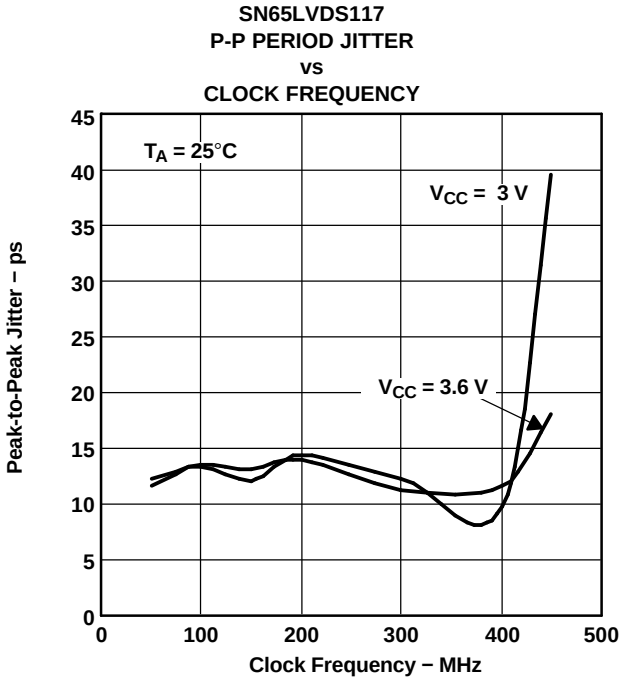
Figure 11.

TYPICAL CHARACTERISTICS (continued)



NOTES: Input: 2^{15} PRBS with peak-to-peak jitter < 115 ps at 100 Mbps, all outputs enabled and loaded with differential 100-Ω loads, worst-case output, supply decoupled with 0.1-µF and 0.001-µF ceramic 0805-style capacitors 1 cm from the device.

Figure 12.



NOTES: Input: 50% duty cycle square wave with jitter period < 10 ps at 100 MHz, all outputs enabled and loaded with differential 100-Ω loads, worst-case output, supply decoupled with 0.1-µF and 0.001-µF ceramic 0805-style capacitors 1 cm from the device.

Figure 13.

TYPICAL CHARACTERISTICS (continued)

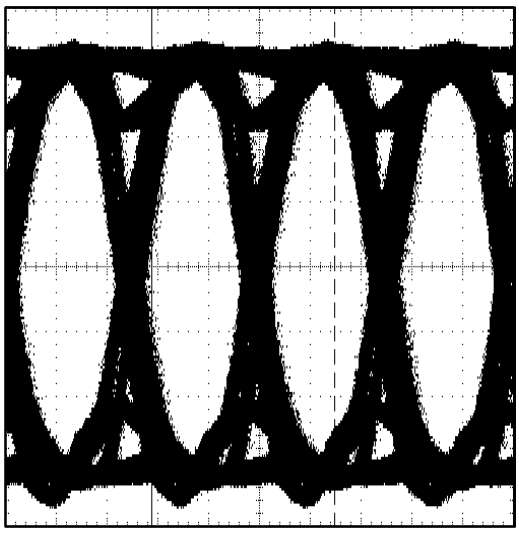


Figure 14. Typical Differential Eye Pattern at 400 Mbps

APPLICATION INFORMATION

FAIL SAFE

A common problem with differential signaling applications is how the system responds when no differential voltage is present on the signal pair. The LVDS receiver is like most differential line receivers, in that its output logic state can be indeterminate when the differential input voltage is between –100 mV and 100 mV and within its recommended input common-mode voltage range. Hovever, TI LVDS receivers handles the open-input circuit situation differently.

Open-circuit means that there is little or no input current to the receiver from the data line itself. This could be when the driver is in a high-impedance state or the cable is disconnected. When this occurs, the LVDS receiver pulls each line of the signal pair to near V_{CC} through 300-kΩ resistors as shown in Figure 15. The fail-safe feature uses an AND gate with input voltage thresholds at about 2.3 V to detect this condition and force the output to a high-level regardless of the differential input voltage.

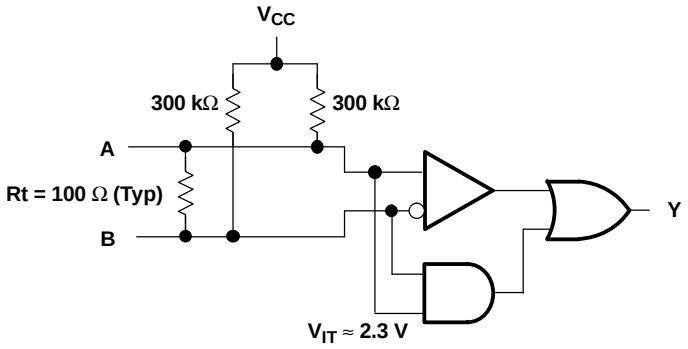


Figure 15. Open-Circuit Fail Safe of the LVDS Receiver

It is only under these conditions that the output of the receiver will be valid with less than a 100 mV differential input voltage magnitude. The presence of the termination resistor, Rt, does not affect the fail-safe function as long as it is connected as shown in Figure 15. Other termination circuits may allow a dc current to ground that could defeat the pullup currents from the receiver and the fail-safe feature.

CLOCK DISTRIBUTION

The SN65LVDS109 and SN65LVDS117 devices solve several problems common to the distribution of timing critical clock and data signals. These problems include:

- Excessive skew between the signals
- Noise pickup over long signaling paths
- High power consumption
- Control of which signal paths are enabled or disabled
- Elimination of radiation from unterminated lines

Buffering and splitting the two related signals on the same silicon die minimizes corruption of the timing relation between the two signals. Buffering and splitting the two signals in separate devices will introduce considerably higher levels of uncontrolled timing skew between the two signals. Higher speed operation and more timing tolerance for other components of the system is enabled by the tighter system timing budgets provided by the single die implementations of the SN65LVDS109 and SN65LVDS117.

The use of LVDS signaling technology for both the inputs and the outputs provides superior common-mode and noise tolerance compared to single-ended I/O technologies. This is particularly important because the signals that are being distributed must be transmitted over longer distances, and at higher rates, than can be accommodated with single-ended I/Os. In addition, LVDS consumes considerably less power than other high-performance differential signaling schemes.

APPLICATION INFORMATION (continued)

The enable inputs provided for each output pair may be used to turn on or off any of the paths. This function is required to prevent radiation of signals from the unterminated signal lines on open connectors, such as when boards or devices are being swapped in the end equipment. The individual bank enables are also required if redundant paths are being utilized for reliability reasons.

The diagram below shows how a pair of clock (C) and data (D) input signals is being identically repeated out two of the available output pairs. A third output pair is shown in the disabled state.

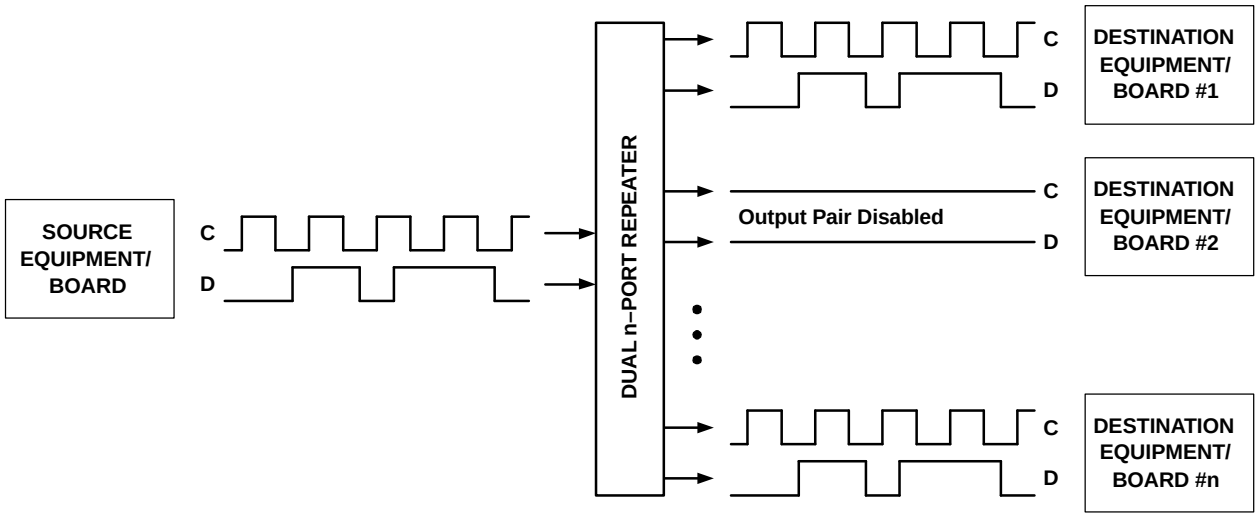


Figure 16. LVDS Repeating Splitter Application Example Showing Individual Path Control

INPUT LEVEL TRANSLATION

An LVDS receiver can be used to receive various other types of logic signals. Figure 17 through Figure 25 show the termination circuits for SSTL, HSTL, GTL, BTL, LVPECL, PECL, CMOS, and TTL.

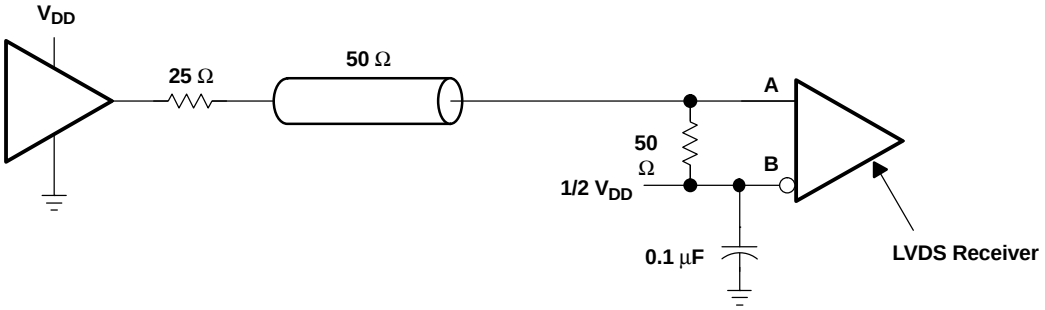


Figure 17. Stub-Series Terminated (SSTL) or High-Speed Transceiver Logic (HSTL)

APPLICATION INFORMATION (continued)

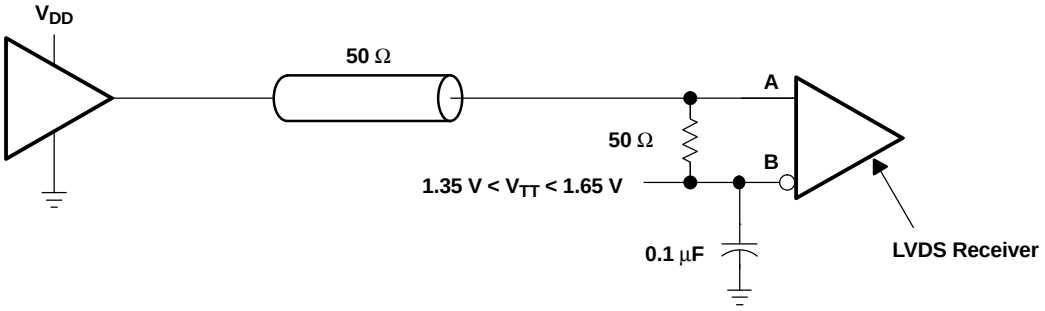


Figure 18. Center-Tap Termination (CTT)

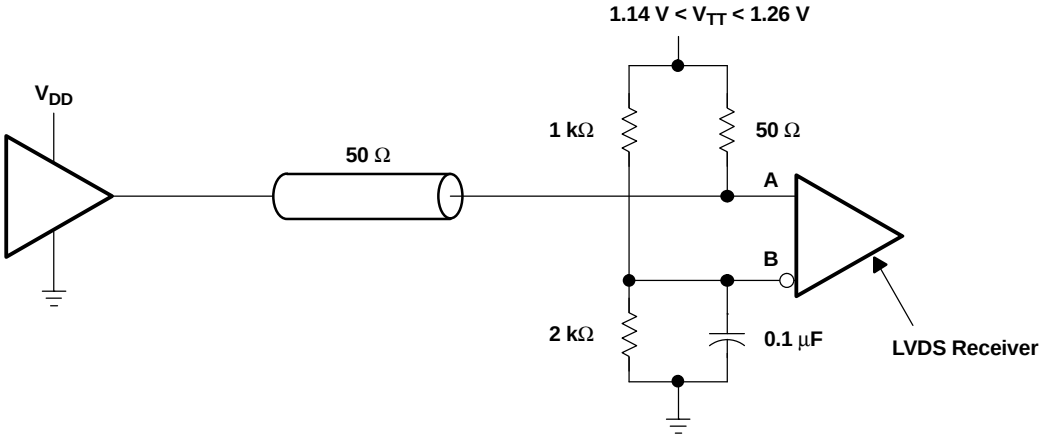


Figure 19. Gunning Transceiver Logic (GTL)

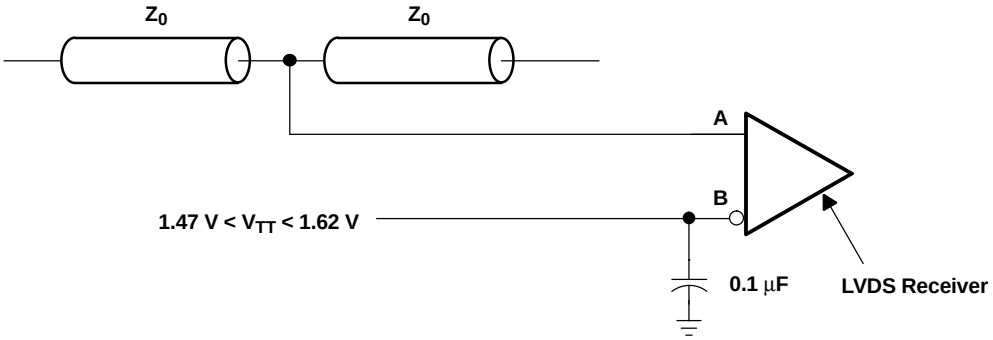


Figure 20. Backplane Transceiver Logic (BTL)

APPLICATION INFORMATION (continued)

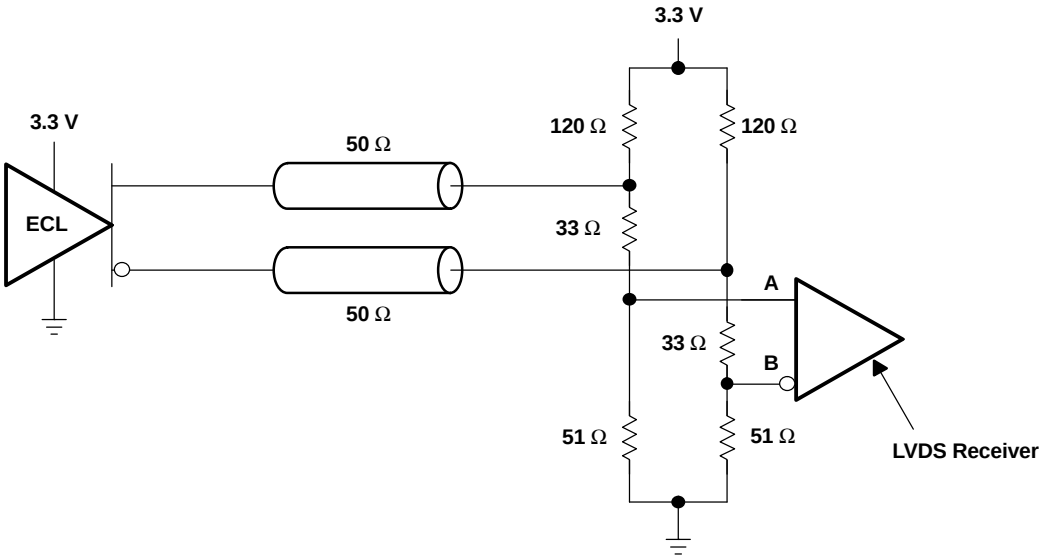


Figure 21. Low-Voltage Positive Emitter-Coupled Logic (LVPECL)

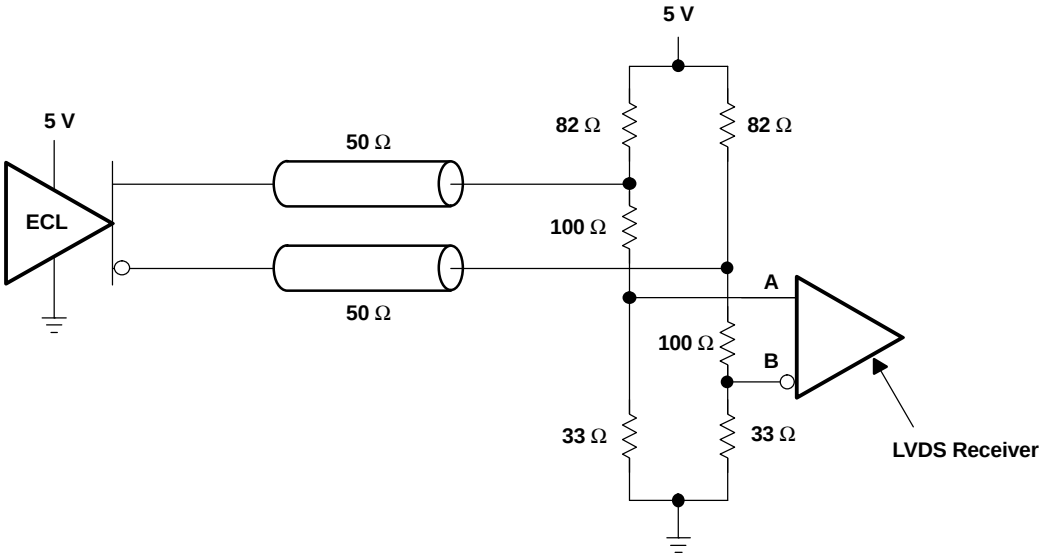


Figure 22. Positive Emitter-Coupled Logic (PECL)

APPLICATION INFORMATION (continued)

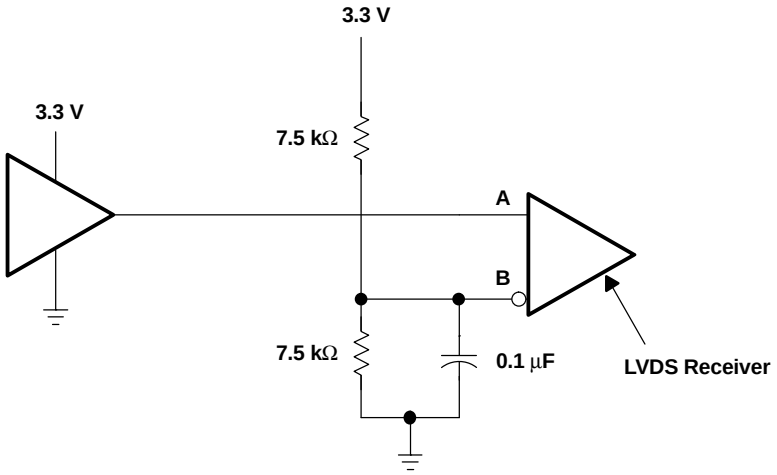


Figure 23. 3.3-V CMOS

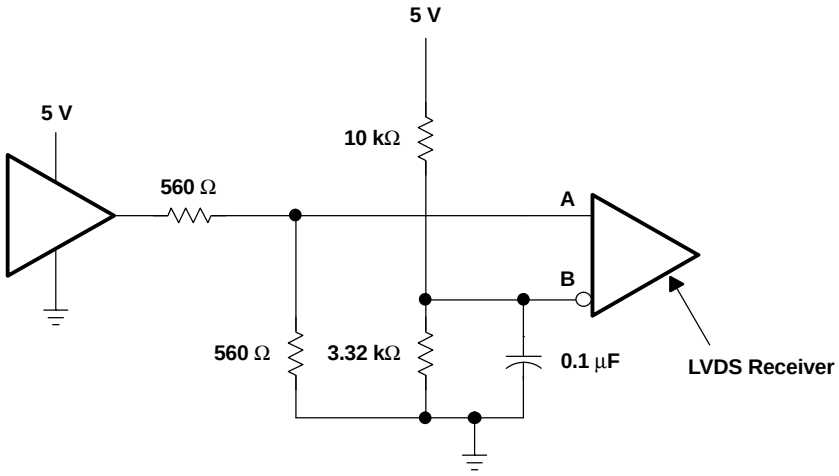


Figure 24. 5-V CMOS

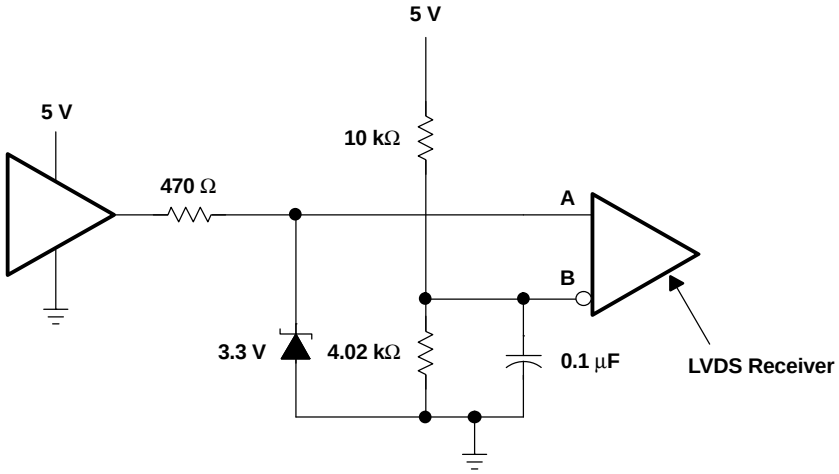


Figure 25. TTL

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN65LVDS109DBT	ACTIVE	TSSOP	DBT	38	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	LVDS109	Samples
SN65LVDS109DBTG4	ACTIVE	TSSOP	DBT	38	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	LVDS109	Samples
SN65LVDS117DGG	ACTIVE	TSSOP	DGG	64	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	LVDS117	Samples
SN65LVDS117DGGG4	ACTIVE	TSSOP	DGG	64	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	LVDS117	Samples
SN65LVDS117DGGR	ACTIVE	TSSOP	DGG	64	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	LVDS117	Samples
SN65LVDS117DGGRG4	ACTIVE	TSSOP	DGG	64	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	LVDS117	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

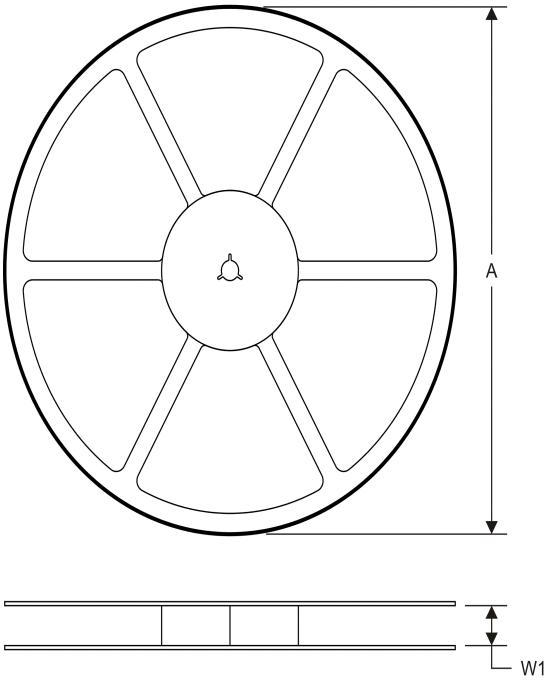
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

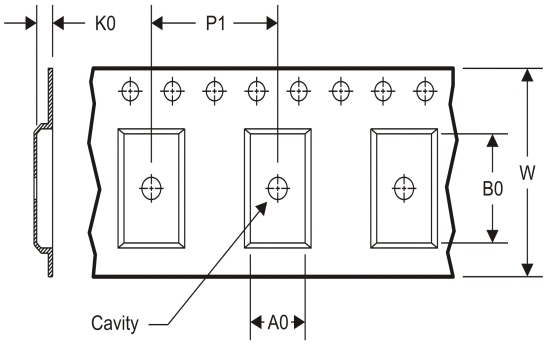
(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



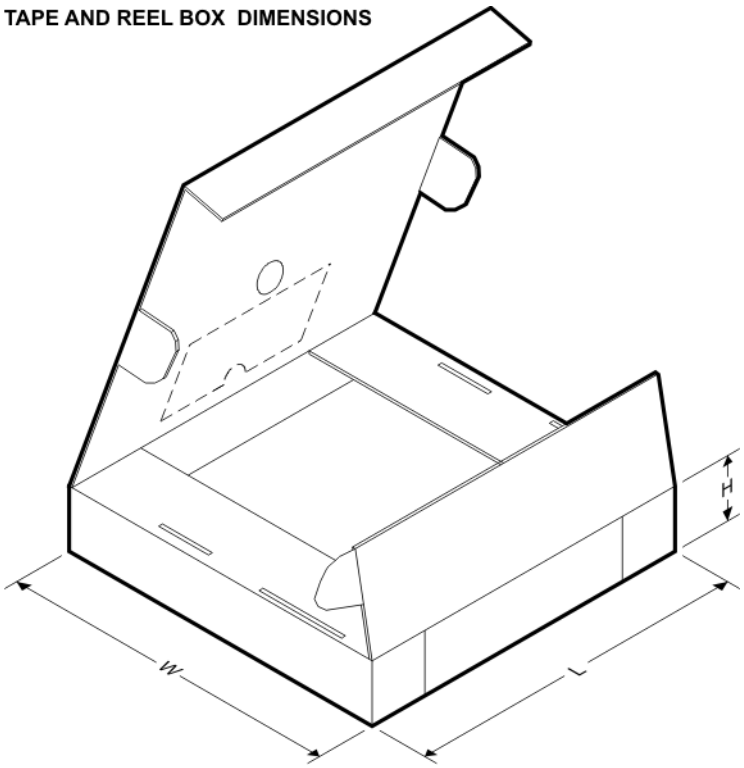
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

TAPE AND REEL INFORMATION

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN65LVDS117DGGR	TSSOP	DGG	64	2000	330.0	24.4	8.4	17.3	1.7	12.0	24.0	Q1

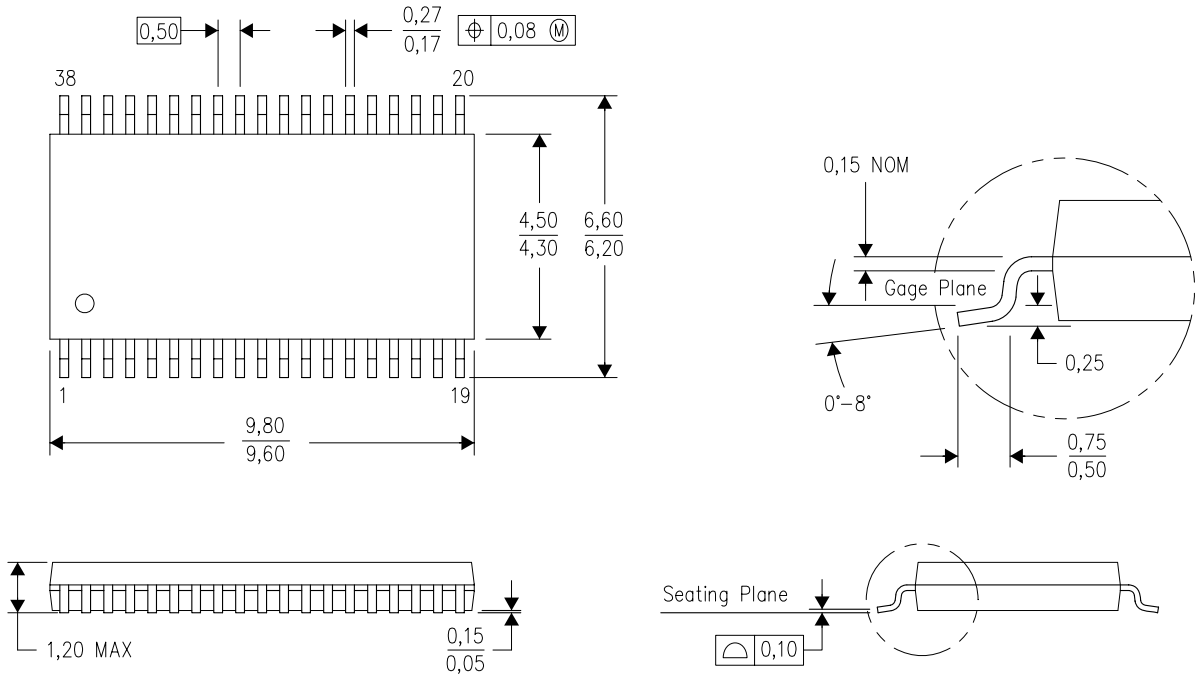
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN65LVDS117DGGR	TSSOP	DGG	64	2000	367.0	367.0	45.0

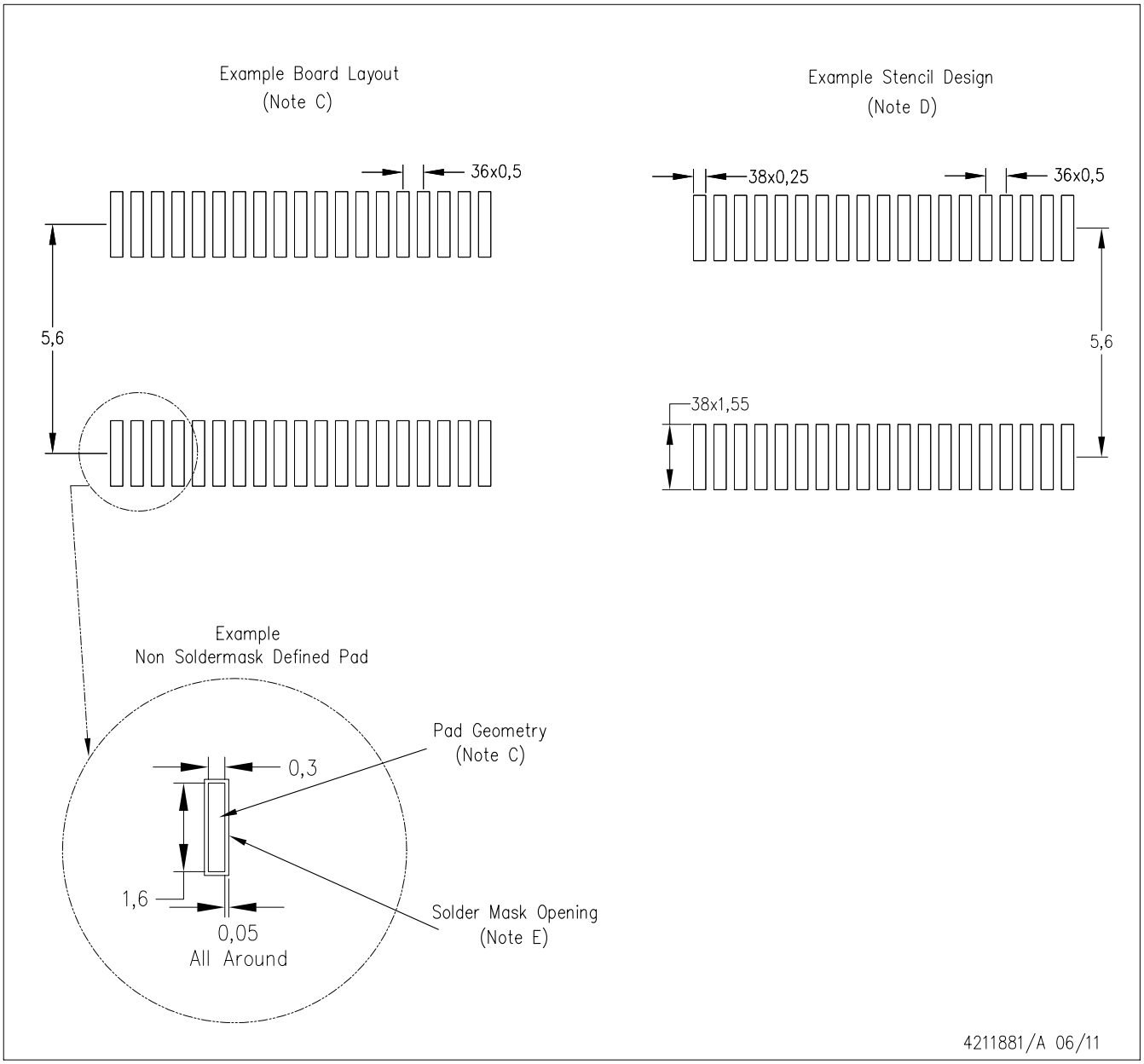
DBT (R–PDSO–G38) PLASTIC SMALL OUTLINE



4073252-6/I 03/11

NOTES:
A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M–1994.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion.
D. Falls within JEDEC MO–153.

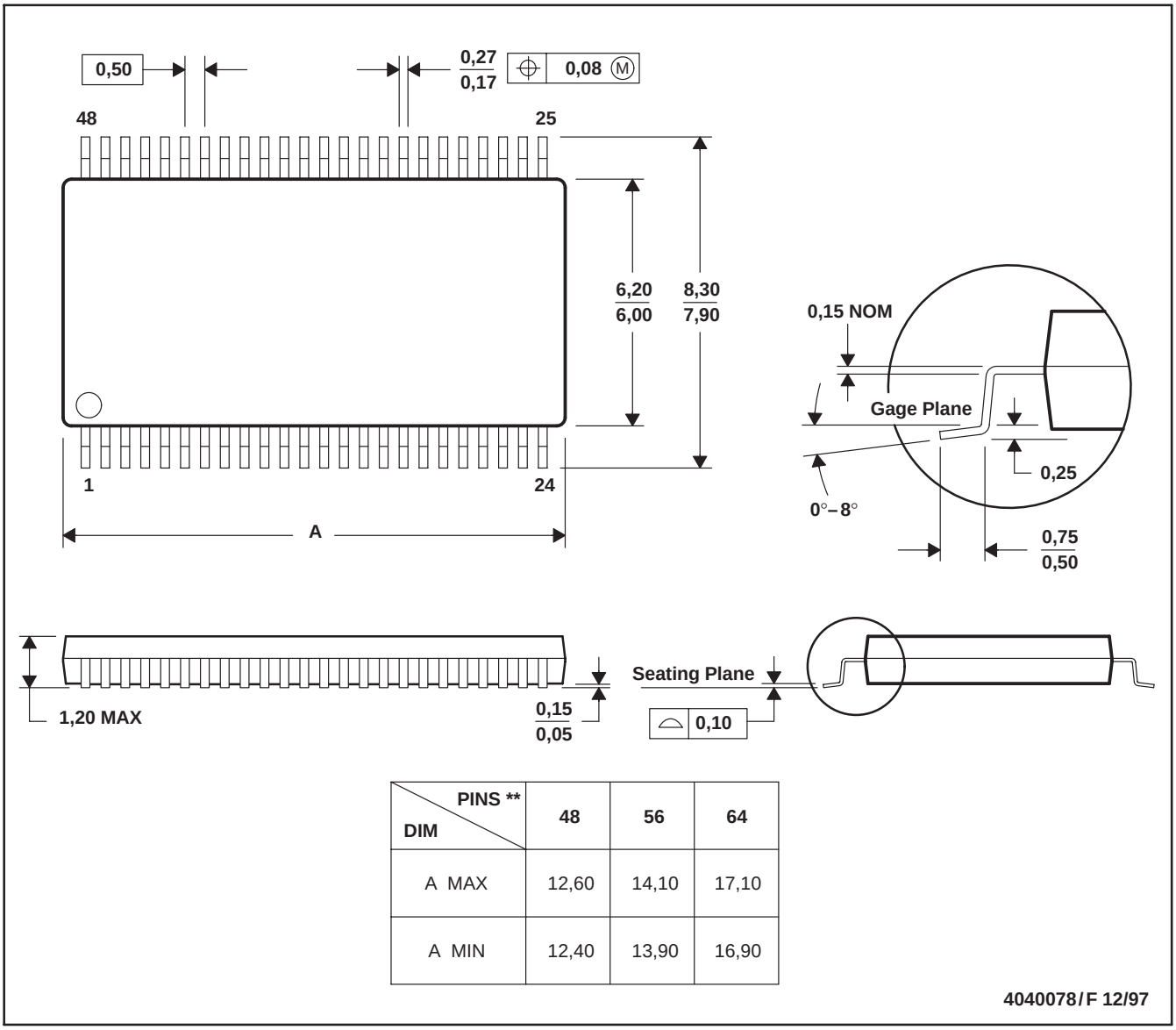
DBT (R–PDSO–G38) PLASTIC SMALL OUTLINE



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–7351 is recommended for alternate designs
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC–7525.
E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

DGG (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

48 PINS SHOWN



DIM \ PINS **	48	56	64
A MAX	12,60	14,10	17,10
A MIN	12,40	13,90	16,90

NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold protrusion not to exceed 0,15.
D. Falls within JEDEC MO-153

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